

AMENDMENT TO CLAIMS

In the Claims

Please CANCEL claims 1-48 without prejudice or disclaimer.

Please ADD new claims 49-88.

A copy of all pending claims and a status of the claims is provided below.

1-48 (Cancelled).

49. (New) A method for producing a free-standing elastomeric nanocomposite film, said method comprising the steps of:

contacting a substrate with at least one nanoparticle species by immersing the substrate in a solution containing the at least one nanoparticle species to form a nanoparticle layer on the substrate;

contacting the nanoparticle-layered substrate with at least one crosslinker reagent by immersing the nanoparticle-layered substrate into a solution containing the at least one crosslinker reagent to form a crosslinker layer on the nanoparticle-layered substrate to form an elastomeric film on the substrate; and

removing the elastomeric nanocomposite film from the substrate to form said free-standing elastomeric film.

50. (New) The method of claim 49, further comprising the step of repeating said first contacting step and said second contacting step to form an elastomeric film having at least two bilayers.

51. (New) The method of claim 49, further comprising the step of forming at least one polymer layer by contacting at least one of the nanoparticle layer, the crosslinker layer or the substrate with at least one polymer species to form the at least one polymer layer.

52. (New) The method of claim 51, wherein the polymer species is selected from the group consisting of one or more of poly(urethane), poly(etherurethane), poly(esterurethane), poly(urethane)-co-(siloxane), and poly(dimethyl-co-methylhydrido-co-3-cyanopropyl, methyl) siloxane.

53. (New) The method of claim 49, further comprising the step of repeating said contacting steps to form a plurality of alternating nanoparticle and crosslinker layers.
54. (New) The method of claim 53, further comprising the step of forming at least one polymer layer by contacting at least one of the nanoparticle layer, the crosslinker layer or the substrate with at least one polymer species to form the at least one polymer layer.
55. (New) The method of claim 54, wherein the polymer is selected from the group consisting of one or more of poly(urethane), poly(etherurethane), poly(esterurethane), poly(urethane)-co-(siloxane), and poly(dimethyl-co-methylhydrido-co-3-cyanopropyl, methyl) siloxane.
56. (New) The method of claim 49, wherein said nanoparticle contacting step comprises immersing the substrate in the solution containing the at least one nanoparticle species for a time period in the range of about 1 minute to about 120 minutes.
57. (New) The method of claim 56, wherein the time period is about 60 minutes.
58. (New) The method of claim 49, wherein said crosslinker contacting step comprises immersing the nanoparticle-layered substrate in a solution containing the at least one crosslinker reagent for a time period in the range of about 1 minute to about 30 minutes.
59. (New) The method of claim 58, wherein the time period is about 10 minutes.
60. (New) The method of claim 49, wherein the substrate in said substrate contacting step is selected from the group consisting of a glass slide, single crystal silicon, polycarbonate, kapton, polyethylene rigid polymer materials, flexible polymer materials, ceramics, metal surfaces, etched surfaces, functionalized surfaces, and non-functionalized surfaces.
61. (New) The method of claim 49, further comprising the step of forming a functionalized substrate.
62. (New) The method of claim 61, wherein the substrate is functionalized with a polymer.
63. The method of claim 62, wherein the polymer is an organosilane.

64. (New) The method of claim 49, wherein the at least one nanoparticle species of said nanoparticle contacting step is selected from a group consisting of metallic nanoparticles, semiconducting nanoparticles, magnetic nanoparticles, ceramic nanoparticles, and dielectric nanoparticles, and a combination thereof.

65. (New) The method of claim 49, wherein the nanoparticle species in said substrate contacting step is selected from the group consisting of a gold nanoparticle, a gold alloy nanoparticle, a gold core shell nanoparticle, a silver nanoparticle, a silver alloy nanoparticle, a silver core shell nanoparticle, a platinum nanoparticle, a platinum alloy nanoparticle, a platinum core shell nanoparticle, a palladium nanoparticle, a palladium alloy nanoparticle, a palladium core shell nanoparticle, a copper nanoparticle, a copper alloy nanoparticle, a copper core shell nanoparticle, and a combination thereof.

66. (New) The method of claim 49, wherein the nanoparticle species has a diameter in the range of about 1 nm to about 1000 nm.

67. (New) The method of claim 49, wherein the at least one crosslinker reagent of said crosslinker contacting step has at least two functional groups selected from the group consisting of hydroxyl groups, amino groups, carboxyl groups, carboxylic acid anhydride groups, mercapto groups, hydrosilicon groups, and a combination thereof.

68. (New) The method of claim 67, wherein the crosslinker reagent is mercaptoethanol.

69. (New) A method for producing a nanocomposite film, said method comprising the steps of:
contacting a substrate with at least one species of a nanoparticle and at least one crosslinker reagent to produce a nanocomposite film having at least two alternating layers including a nanoparticle layer and a crosslinker layer;
contacting the surface of the nanocomposite film with a resin; and
treating the resin on the nanocomposite film to form an abrasion resistant matrix on the nanocomposite film.

70. (New) The method of claim 69, further comprising the step of removing the resin-coated nanocomposite film from the substrate to produce a free-standing resin-coated nanocomposite film.

71. (New) The method of claim 69, wherein the nanocomposite film is functionalized by contacting a surface of the nanocomposite film with a crosslinker.

72. (New) The method of claim 69, wherein the resin in said resin contacting step is an abrasion resistant resin selected from the group consisting of thermosetting resins, photosetting resins, phenolformaldehyde, phenol resins, epoxy resins, polysiloxane resins, polyurethane, and poly(etherurethane) resins.

73. (New) The method of claim 69, wherein said resin contacting step comprises applying the resin by a method selected from the group consisting of spin coating, spraying, web-based processes, ink jet printing, and a combination thereof.

74. (New) The method of claim 69, wherein said treating step comprises heating the resin on the nanocomposite film.

75. (New) The method of claim 69, wherein said treating step comprises irradiating the resin with at least one of infrared light, UV light or visible light.

76. (New) The method of claim 69, wherein said treating step comprises drying the resin.

77. (New) The method of claim 69, wherein the resin in said resin contacting step forms a transparent coating.

78. (New) The method of claim 69, wherein the nanoparticles in the nanoparticles layer are covalently integrated with the resin to form an abrasion resistant coating.

79. (New) The method of claim 69, wherein said removing step comprises removing the resin-coated nanocomposite film from the substrate by a method selected from the groups consisting of chemical dissolution of the substrate, mechanical removal, subambient removal, heating,

irradiating with UV light, irradiating with infrared light, irradiating with visible light, and a combination thereof.

80. (New) The method of claim 69, further comprising the step of forming at least one polymer layer by contacting at least one of the substrate, the nanoparticle layer or the crosslinker layer with at least one polymer species to form a polymer layer.

81. (New) The method of claim 81, wherein the polymer is an organosilane.

82. (New) The method of claim 82, wherein the polymer is selected from the group consisting of one or more of poly(urethane), poly(etherurethane), poly(esterurethane), poly(urethane)-co-(siloxane), and poly(dimethyl-co-methylhydrido-co-3-cyanopropyl, methyl) siloxane.

83. (New) The method of claim 69, wherein the nanoparticle in said substrate contacting step is selected from the group consisting of metallic nanoparticles, semiconducting nanoparticles, magnetic nanoparticles, ceramic nanoparticles, and dielectric nanoparticles, and a combination thereof.

84. (New) The method of claim 69, wherein the substrate in said substrate contacting step is selected from the group consisting of a glass slide, single crystal silicon, polycarbonate, kapton, polyethylene rigid polymer materials, flexible polymer materials, ceramics, metal surfaces, etched surfaces, functionalized surfaces, and non-functionalized surfaces.

85. (New) The method of claim 69, wherein the crosslinker reagent in said substrate contacting step has at least two functional groups selected from the group consisting of hydroxyl groups, amino groups, carboxyl groups, carboxylic acid anhydride groups, mercapto groups, hydrosilicon groups and a combination thereof.

86. (New) The method of claim 69, wherein the crosslinker reagent is mercaptoethanol.

87. (New) The method of claim 69, wherein the nanoparticle species in said substrate contacting step is selected from the group consisting of a gold nanoparticle, a gold alloy nanoparticle, a gold core shell nanoparticle, a silver nanoparticle, a silver alloy nanoparticle, a silver core shell nanoparticle, a platinum nanoparticle, a platinum alloy nanoparticle, a platinum

core shell nanoparticle, a palladium nanoparticle, a palladium alloy nanoparticle, a palladium core shell nanoparticle, a copper nanoparticle, a copper alloy nanoparticle, a copper core shell nanoparticle, and a combination thereof.

88. (New) The method of claim 69, wherein the nanoparticle species has a diameter in the range of about 1 nm to about 1000 nm.